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ABSTRACT

Performance objectives are stated for the unit describing a course in aeronautics with emphasis on pre-flight facts and the physical principles involved in flight. Prepared for the Dade County Florida Quinmester Program, it offers an introduction to navigation, an opportunity to construct a flying test model and, as an optional learning experience, a chance to pilot a modern aircraft under the supervision of an FAA certified flight instructor. Also included are lists of possible experiments, experiences, demonstrations, projects, field trips, films and film loops, and related problems. A course outline is provided, as well as a master sheet showing the relationship of each suggested activity to the objectives of the package. (TS)

AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

INTRODUCTION TO AERONAUTICS

5347.01
5348.01

SCIENCE

(Experimental)

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1971

INTRODUCTION TO AERONAUTICS

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SCIENCE

(Experimental)

Written by James P. Parrott

for the

DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Florida
1971

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TABLE OF CONTENTS

INTRODUCTION TO AERONAUTICS

COURSE DESCRIPTION

This is a course in aeronautics which places emphasis on pre-flight facts and the physical principles involved in flight. It offers an introduction to navigation, an opportunity to construct a flying test model, and, as an optional learning experience, a chance to pilot a modern aircraft while under the supervision of an FAA certified flight instructor.

ENROLLMENT GUIDELINES

1. An interest or a curiosity concerning aviation, aeronautics, or aero-space.

2. Success will be enhanced if the student has completed courses in General Science, Earth Science, Geometry, Algebra or other science or mathematics disciplines.

STATE ADOPTED TEXTS:

NONE.

Even though there are no state adopted texts for this course, the three references listed below are very appropriate texts.

1. Aviation Fundamentals. Sanderson Films, Inc. Wichita, Kansas, 1969.

2. Private Pilot's Handbook of Aeronautical Knowledge. Superintendent of Documents, U. S. Government Printing Office, Washington, D.C., 1965 - $2.75.

STATE ADOPTED TEXTS (CONT'D)

Fundamentals of Aviation and Space Technology. University of Illinois, Institute of Aviation, 318 Civil Engineering Hall, University of Illinois, Urbana, Illinois, 1963.

PERFORMANCE OBJECTIVES

The student will:

1. Diagram the four forces acting upon an airplane in flight.

2. By use of a model with movable controls, identify the function of the aileron, the rudder, and the elevators.

3. Locate the center of gravity on a loading chart.

4. Diagram the strokes of a four-cycle engine.

5. Illustrate through the use of diagrams, the following aircraft systems:
   a. The fuel system
   b. The carburetor system (including formation of ice in the venturi)
   c. The ignition system
   d. The lubrication system
   e. The instrument systems as they apply to the engine.

6. Prepare a graph showing each of the following:
   a. The effect of angle of bank on stall speed.
   b. The effect of altitude and temperature on take-off performance.
   c. The effect of gross weights on angle of attack and stall speed.
   d. The use of a cruise-control chart.

7. Diagram a wind tunnel.

PERFORMANCE OBJECTIVES (CONT'D)

8. Diagram a wind triangle.

9. Investigate pertinent parts of the Federal Air Regulations (Parts 61 and 91).

10. Compute the weight and balance of an aircraft that he will ride in.

11. Demonstrate an interest in aviation by:
    a. Writing a paper on career opportunities in aviation
    b. Visiting and reporting on a local aviation activity such as an F.A.A. flight service center, or
    c. Lecturing to the class on how aeronautics is directly related to aerospace.

12. Given selected criteria or speaking models, the student will practice good diction and enunciation in English so that he could qualify for a radiotelephone license third class.

13. Maintain straight and level flight while on a demonstration ride in a modern aircraft (optional).

14. Point out five landmarks from the air which can be identified from reference to a U. S. Sectional Chart (optional).

15. Locate 10 places on a chart by latitude and longitude.

16. Fly a model airplane he has constructed himself.

COURSE OUTLINE

I. Pre-Flight Facts

- A. Aircraft components
- B. Forces affecting flight
- C. Engine power cycle
- D. Engine support systems
  1. Fuel
  2. Electrical
  3. Vacuum
     - a. Engine driven
     - b. Venturi driven

II. Weight and Balance

- A. Computation method
- B. Graph method
- C. Table method

III. Aerodynamic Theory

- A. Air as a fluid
- B. Behavior of air
  1. At subsonic speeds
  2. At transonic speeds
  3. At supersonic speeds
- C. Lift
  1. Positive
  2. Negative

IV. Building a Flying Model

- A. Application of scale drawings
- B. Stress analysis and load factors involved in flight

COURSE OUTLINE (CONT'D)

C. Effects of weight and balance on flight

V. Introduction to Navigation

A. Principles of latitude and longitude

B. Uses and errors of the magnetic compass

C. Methods of map projection
1. Lambert Conformal
2. Mercator

D. Pilotage

VI. Field Trip to Local Flight School

A. Describing the activities in knowledgeable terms

B. Applying classroom theory to a real-life experience.

EXPERIMENTS AND EXERCISES

Sanderson, Aviation Fundamentals. Wichita, Kansas: Sanderson, 1969.
1. Airplane Components
   a. Sketch Figure A-1, (pp. 1-2)
   b. Manipulate controls, study effect (Sanderson or Cessna Model)
2. Engine Power Cycle
   a. Sketch Figures A-10 through A-13.
   b. Run model airplane engine
3. Engine Support Systems
   a. Sketch pp. 1-21; 1-22; 1-23; 1-26
   b. 3-axis control instruments
      1. Gyro-controlled (pp. 1-13)
      2. Pitot-Static (pp. 1-22)

EXPERIMENTS AND EXERCISES (CONT'D)

4. Weight and Balance (pp. 3-12)
   a. Location of C. G. (pp.3-14)
   b. Use of Fulcrum and Datum Line (pp. 3-14)
5. Effect of Controls
   a. On a balsa glider
   b. On a rubber-band powered model
6. Finding Latitude and Longitude by referring to chart symbols (pp. 6-4; 6-5)
7. Navigation Plotter (pp. 620-621)
   a. Measuring angles
   b. Measuring distance
8. The Wind Triangle (pp. 5-19) Ex. pp. 5-24;
9. The Pocket Computer (Circular Slide Rule) (pp 5-8 through 5-16)
10. The Aircraft Check List (pp. 1-32;1-34)

Federal Aviation Agency, Private Pilot's Handbook of Aeronautical Knowledge, Washington, D.C.: U.S. Gov't Printing Office, 1965.

11. Function of Controls (Sketch Fig. 15 R, p. 10)
12. Engine Power Cycle
    a. Sketch Fig. 87 (p. 81)
    b. Run up model airplane engine
13. Engine Support Systems
    a. Sketch Fig. 88 (p. 84)
    b. 3-Axis control instruments
       1. Gyro-(p. 92, Figs. 94-99)
       2. Pitot-Static (Fig. 89, p. 87)
14. Weight and Balance (p. 98- sample problem)
15. Effect of Controls - (Demonstration by Instructor using model)
16. Finding Latitude and Longitude (p. 63)
17. The Wind Triangle (p. 72)
18. Flight Computer-Slide Rule Face (pp. 129-137)

DEMONSTRATIONS

Sanderson, Aviation Fundamentals, Wichita, Kansas: Sanderson, 1969

1. Using Sanderson movable-control model: Demonstrate movement of flight controls.
   a. 3-axes
   b. Controls work
2. 4-forces (A-3)
3. Using cut-away instruments (available on request, Miami Senior High Science Department), demonstrate: Aneroid Barometer-Altimeter; Gyroscopic Turn-and-Bank; Directional Gyro; Artificial Horizon (pp. 1-16)
4. Principle of The Bourdon Tube in engine pressure instruments. (A simple demonstration of how pressure causes extension of the tube can be done with a New Year's party toy)
5. Concept of latitude and longitude with aid of a world globe (A-23)
6. Use a Mark II Plotter (or similar) to draw angles on the blackboard. Students should follow instructions using a plotter at their desks.
7. Computation of the True Course on a U. S. Sectional chart. (Students should be supplied with similar charts for accomplishing tasks relative to measuring True Courses at their desks.
8. Using a classroom model (Or "Enco" pocket computer) calculator, demonstrate the solving of multiplication, division and time and distance problems.
9. Manner of "reading the check-list" (pp. 1-32; 1-33; 1-34).
10. Demonstrate by use of a tape records and a microphone, the correct technique for talking on an aircraft radio (pp. 7-26; 7-27)

DEMONSTRATIONS (CONT'D)

Federal Aviation Agency. Private Pilot's Handbook of Aeronautical Knowledge. Washington, D.C., U. S. Gov't Printing Office, 1965.

11. Bernoulli's Principle (Fig. 6, p. 4)
12. "Yield" and "Fail" points of balsa model by exceeding maximum stresses (Use Fig. 18; p. 12 to explain load)
13. Computations for a round-trip flight (Fig. 84, p. 76 should be put on board)
14. By board diagram, demonstrate the filling in of a Flight Plan Form (p. 159; Fig. 147)
15. Demonstrate by a number of small compasses magnetic attraction (p. 65, Fig. 67, 169, 170)

PROJECTS

1. Construct a flying model airplane.

2. Compute the weight and balance of a Cessna 150 and show these computations on a graph.

3. Construct by diagram a wind triangle.

4. Compute, by theory, a cross-country flight using the navigational skills of dead reckoning. (deductive reckoning).

5. Act as navigator on a real cross-country flight.

6. Act as student pilot on a real cross-country flight.

7. Construct a wind tunnel.

8. Visit an FAA Flight Service Center.

PROJECTS (CONT'D)

9. Visit the U. S. Weather Bureau

10. Construct a simple telegraphic key and sounder.

11. Learn the International Morse Code

12. Make a home movie showing birds in flight.

13. Construct a simple sextant to measure the altitude of heavenly bodies (especially the sun).

14. Learn the "shorthand" of air traffic control clearances.

15. Bring a VHF radio to class, and demonstrate the use of proper frequencies by monitoring airline and control tower channels.

16. Make an oral report on recent aviation/aerospace developments which have been written up in: Flying, Science World, Aviation Technology, or other scientific journals.

17. Write to the Educational Section, Aerospace Program, Cape Kennedy, Florida, for still pictures of vehicles and components of the U.S. Aerospace Program.

REPORTS

1. The effect of the location of the center of gravity on aircraft performance (preferably the second week of the quin).

2. The effect of moving a wing section through the air at (1) subsonic speeds (2) transonic speeds (3) supersonic speeds. Use illustrations.

3. The time "razzle dazzle" - showing clearly the method used to compute local civil time from Greenwich Civil Time.

4. An oral report based on an article which the student has read in a current aviation or aeronautical journal.

5. "My First Flight....As Pilot!" This should be written on the first class day following the field trip. Emphasis should be place on achieving a "de-briefing" type of report complete with as many knowledgeable references as possible.

6. A self-evaluation at the conclusion of this course which would include the student's appraisal of his own progress, and the plans he has for the future which would include knowledge gained in the course. (Followpup forms might be distributed for seniors so that progress in aeronautical sciences could be kept for charting and reference).

FIELD TRIPS

(Strongly Recommended)

1. A local FAA-Approved flight school (for an introductory ride in an airplane) at either:
   1. Tamiami Airport or
   2. Opa Locka Airport.

2. The George T. Baker Aviation School
   3275 Northwest 42nd Avenue
   Miami, Florida 33142 Telephone: 633-7496

   Persons to contact: Mr. Joseph Yaworski; Mr. Joseph Bunn, Mr. Smith, Principal

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(Recommended)

3. Museum of Science-Planetarium
   3280 S. Miami Avenue
   Miami, Florida Tel: 854-4242

4. Eastern Airlines Flight Simulator
   Terminal Area International Airport
   LeJeune Road, Miami, Florida

   Person to contact: Mr. Ralph Heller (Simulator Personnel)

5. International Airlines Terminal
   LeJeune Road, Miami, Florida

   (Teacher-guided tour)

6. Tamiami Control Tower and Flight Service Facility
   Located: On Tamiami Airport
   Operated by: The Federal Aviation Agency

   Person to contact: Mr. John Kostura, Chief
   Telephone: 238-8331

SPEAKERS

1. Mr. Frank M. Williams
   Pan American World Airways
   5200 N. W. 36th Street, Miami, Florida
   Telephone: 637-2122

2. Mr. Lewis P. Sheets
   British West Indies Airways
   5320 Filmore Street
   Hollywood, Florida

3. Mr. Paul J. Slayden
   Eastern Air Lines
   5840 S. W. 85th Street, Miami, Florida
   Telephone: 667-3047

4. Mr. Joseph Yaworski
   (By arrangement with the principal)
   George T. Baker Aviation School
   3275 Northwest 42nd Avenue
   Miami, Florida 33142
   Telephone: 633-7496

5. Mr. Ed Keyes
   Miami Chamber of Commerce
   1200 Biscayne Boulevard
   Miami, Florida Telephone: 377-4711

6. Mr. Pat Murphy
   Coral Gables Times
   4627 Ponce de Leon Boulevard.
   Coral Gables, Florida
   Telephone: 661-2501

7. Mr. Sylvan Meyer
   Editor, Miami News
   1 Herald Plaza
   Miami, Florida
   Telephone: 350-2948, 350-2111

8. Mr. Robert Keene
   Miami-Dade Junior College
   Aerospace Dept.

SPEAKERS (CONT'D)

Special note: NASA Speaker Services welcomes inquiries. Address to same code FGE, Washington, D.C. 20546

RELATED PROBLEMS

I. Aerodynamics

A. Types and structures of wings
(Cantilever, Delta, Elliptical, Negative, Stagger and Parasol.)

B. Behavior of air at different speeds
(Subsonic, Transonic, Supersonic)

C. Strengths of Materials
(Wood, aluminum, steel, titanium)
1. Stress analysis-load a model wing until the yield point-failure point
2. Explain importance of thicknesses (strength to weight ratios)

II. Mathematics

A. Determination of Center of Gravity
(Weights and moment arms)

B. Pressure altitude, temperature and calibrated airspeed taken into account in computing true airspeed

Ex. C.A.S.	P.A.	TEMP C.	T.A.S.
160 Kts.	5,000	Plus 10	175 Kts.

(Solution to be worked by pocket computer)

C. Time-Rate-Distance Problems

RELATED PROBLEMS (CONT'D)

Ex.: An aircraft travels 140 Nautical Miles in 90 minutes... what is its Ground Speed in Knots? In Statute Miles Per Hour?

(Solution by computer)

III. General Science

A. Bernoulli's Principle

B. Effect of temperature on air density

C. Laws of physics on which the"phenomenon" of flight depends.
1. Relationship of airspeed to lift
2. Drag: Parasite, Induced

FILMS

1. Goofy's Glider (see note below on all SSA films)
SD-16-7052 8.1 minutes, C
Walt Disney Prod. Available through SSA*
Rental cost.....$2.50

2. Principles of Flight
SL-16-1009, 16.8 minutes, B & W on 400 Ft. reel
Eastmen Classroom Films; available through SSA.
Rental cost.....$2.50

3. Airflow at Subsonic, Transonic and Supersonic Speeds
18 minutes each, Color
FREE through: Shell Film Library
450 N. Meridian Street
Indianapolis, Ind.

4. Density Altitude
Fa-603A 29 min. Color, 1966 FAA Productions
FAA Film Library * (see note below)
FREE

FILMS (CONT'D)

5. Whispering Wings
An excellent film on motorless flight
SD-16-7012 17.4 min. Color on 800 ft. reel
Prod. in South Africa, featuring Rene Comte
Available through the SSA*
Rental cost.....$7.50

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Addresses: The Soaring Society of America
Mr. Walter B. Hausler, Chairman
SSA Photographic Committee
67 Fisher Road
Rochester, N. Y. 14624

Federal Aviation Administration
Film Library, AC-921
Aeronautical Center
P. O. Box 25082
Oklahome City, Oklahoma 73125

NOTE: List of FREE films available on request

NASA, Distribution and Central Film Depository Services, FAD-2, Washington, D.C., 20546. NOTE: Write for FREE LOAN film list.

FILM LOOPS AND FILM STRIPS

1. Experimental Weightlessness, Color, 3 min. silent. Film Associates. Animation is used to show the flight path of a plane in weightless experiments. Includes detailed teaching guide. (Film Loop)

2. Free Fall in Space. Color, 3 ½ min. silent. Film Associates. Shows why a satellite remains in orbit. (Film Loop)

3. Aircraft in Flight. Civil Air Patrol. Color 60 frames. Principles of flight. Flight

FILM LOOPS AND FILM STRIPS (CONT'D)

systems and structural units. Includes recording and script. (Filmstrip)

4. Aviation-Where Career Opportunities are Bright National Aerospace Education Council. Color, 152 frames. Includes a comprehensive Counselor's Guide and 33 1/3 rpm recording (Filmstrip)

5. Science at the Airport, McGraw-Hill Film Texts. Color, 43 frames. Discusses the applications of scientific principles related to conditions to be found at a large airport. (Filmstrip)

6. Power for Aircraft. Civil Air Patrol. Color 52 frames. Discusses interna. combustion engines for aircraft. Includes recording and scr:pt. (Filmstrip)

7. Airports, Airways and Electronics. Civil Air Patrol. Color, 59 frames. Shows growth and development of airways, electronics, air traffic control. Includes recording and script. (Filmstrip)

SUPPLEMENTAL FILMS OF INTEREST

8. Flight Decision, The. Color 15 min. National Association of State Aviation Officials. A study of the causes of fatal accidents in general aviation. (16 mm. movie)

9. Dream That Wouldn't Down, The. HQk 125. B/W 27 min. NASA. The dream of Dr. Robert Goddard, the father of modern rocketry. Includes historic footage of Dr. Goddard's early experiments. (16 mm movie)

PROGRAMMING SUGGESTIONS

1st Week:

Day

1. Pre-flight Facts - Aircraft Components (See Ex. 7)
2. Engine Power Cycle (See diagram Ex. 7)
3. Engine Support Systems: Fuel; Electrical; Vacuum.
4. The 3-Axes- Instruments and Controls of Altitude
5. Review and Quiz

2nd Week:

Day

1. Introduction of Weight and Balance: Demo: Fulcrum, etc.
2. Computation Method in Aircraft: Problems 3-17; Fig. B-25.
3. Graph Method: (Problems pp. 3-26)
4. Table Method: (Problems pp. 3-31)
5. Effect of Center of Gravity on Aircraft Performance

3rd Week

Day

1. Aerodynamic Theory: Useful shapes, Air as a Fluid, etc.
2. Films: Shell Oil Co. on Subsonic, Transonic Airflow
3. Films: (con't) Shell Oil Co. on Supersonic Airflow
4. Distribution of Model Airplane Materials
5. Begin construction of Flying Model, Sig Cub, or similar

4th Week

Day

1. Model Construction: Fuselage and Landing Gear

2. Model Construction: Left Wing Assembly
3. Model Construction: Right Wing Assembly
4. Model Construction: Empennage Construction
5. Model Construction: Finishing Activities and Pre-Covering

5th Week

Day

1. Model Construction: Covering of Left Wing
2. Model Construction: Covering of Right Wing
3. Model Construction: Covering of Empennage
4. Model Construction: Final Assembly
5. Model Construction: Weight and Balance

6th Week

Day

Day

1. Performance Evaluation of Flying Model: Preferably in Gym.
2. Introduction to Navigation: Principle of Latitude and Longitude.
3. Time Zones in Relation to Longitude
4. Chart Projections Used by Airmen: WAC and Sectional
5. Location of True North vs. Magnetic North Variation

7th Week

Day

1. Aeronautical Symbols: (pp 6-6 through 6-13)
2. Hydrographic Features; Radio-Nav- Symbols; Control zones
3. Uses of the Mark II Plotter: Measuring T.N.; Distances
4. Force Vectors in Navigation: Correcting for Drift.
5. Construction of the Wind Triangle

PROGRAMMING SUGGESTIONS (CONT'D)

8th Week

Day

1. Construct a wind triangle on a Sectional Chart
2. Computation of ETA's by simple mathematics
3. Planning a cross-country flight: Sanderson film: Nav.
4. Solving simple mathematical problems by Pocket Computer
5. Time-Rate-Distance problems using the Pocket Computer

9th Week

Day

1. Motorless Flight: Gliders, Sailplanes, Film: SSA, etc.
2. Film: FAA on Density Altitude, or similar
3. Aircraft Check-lists and their Use
4. Final Exam
5. Field Trip to Local Flight School: Airplane Ride

SUGGESTED DISCUSSION QUESTIONS

1. What is there in aviation for me?
   a. With high school preparation only
   b. With two years of college with special emphasis on aviation training programs available to me in Florida.
   c. With a degree in science from a four-year college or university.

2. How may Aviation Science act as a training ground for Aerospace
   a. Study of space environments
   b. Navigation systems
   c. Manipulative techniques of air and space vehicles

SUGGESTED DISCUSSION QUESTIONS

3. Aviation Science as a means of self-actualization
   a. Levels of pilot grades available to me as a student
   b. Cost factors involved
   c. Careers open (domestic and foreign)
   d. Business advantages of knowing how to pilot company airplane
   e. As an outlet for creative invention
   f. As a recreative activity

4. Methods of Air Transportation
   a. In the past
      1. Flights of historical importance
      2. Military application
   b. In the present
      1. Types of commercial aircraft in use.
      2. Knowledge of general aviation aircraft in use.
   c. In the future
      1. Implications of super-sonic travel
      2. Aircraft designs to come

5. Military significance of air power

6. The airplane and the ecology

7. The place of women in aviation and space
   a. As crew members
   b. As air traffic controllers

8. Business planning utilizing air transportation

ADDITIONAL INNOVATIVE ACTIVITIES

1. Call on FAA personnel to come in during classroom studies of air traffic control. They have been instructed to take part in educational activities.

2. Build shadow-boxes in which scale model scenes (military combat, early antique aviation activity, airline terminal, etc.) can be constructed or exhibit around the school or classroom.

3. Have the field trips photographed in 35mm color slides. Have students assemble the slides in order, and tape an accompaniment in music and voice to show to interested students.

4. Convert the rubber-band model Sig Cub which the students construct to jet power by the addition of the Jetex from England...(Cost $1.50) (Extra fuel pellets about $1.00)

5. Do this simple thrust demonstration. Wrap foil around a match head. When the other end of the match is lighted, the stick will burn into the foil and the match head will ignite. This causes a brief, but impressive, burst of power out of the hole where the stick was.

6. Arrange field trips to the Eastern Airlines simulator or that of National Airlines. They are most cooperative.

7. Organize a school-operated weather center.

8. Have some students assigned to use the high school library as a motivational tool. Display new books on aviation, models, and career possibilities in a special section of the library. Change the display periodically, and give each student an opportunity to become involved.

ADDITIONAL INNOVATIVE ACTIVITIES

9. Organize a very early morning field trip. The students become airborne in the dark and witness a sunrise. They learn, among other things, to "trust" the aircraft instrument systems. The miraculous appearance of a sunrise from altitude is an impressive and stimulating sight.

REFERENCES

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4. Cessna Aircraft Co. An Introductory Aviation Course Guide. Wichita, Kansas: 1969.

5. Conroy, Charles W. and Mehrens, Harold E. Aerospace Education Text. Civil Air Patrol, 1967.

6. Coombs, Charles Aerospace Pilot. San Diego: Morrow 1964. (A guide to the training required for this vocation)

7. Dispatcher...Airline Safety and Economy, The Airline Dispatchers Association.

8. Federal Aviation Agency, Private Pilot's Handbook Of Aeronautical Knowledge. Washington,D.C.: U. S. Gov't Printing Office, 1965.

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11. Hicks, Betty. The Ground School Workbook. Ames, Iowa: Iowa State University Press, 1965.

12. Kane, Robert and Vose, Allen D. Air Transportation. Brown, 1967.

13. Lundquist, Charles A. Space Science. New York: McGraw-Hill, 1966. (An Introduction to Space Science)

14. Nathan, Raymond, Careers in Airlines Operations New York: Walck, 1964.

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REFERENCES (CONT'D)

21. Serling, Robert. The Left Seat. New York: Doubleday, 1966.

22. VanDeventer, C. N. An Introduction to General Aeronautics. Chicago: American Technical Society, 1965.

23. Van Sickle, Neil D. editor. Modern Airmanship. 3rd ed. New York: Van Nostrans, 1966. (Called by some authorities "The Airman's Bible.")

MASTER SHEET - INTRODUCTION TO AERONAUTICS

Objectives	Experiments and Exercises	Student Text	Supplementary References	Films	Film Loops	Film Strips
1	Classroom demonstration model	1-3	** p.1 ** p.7 ** p.12			
2	Sanderson Classroom model	1-11 thru 1-19	** p.9 ** p.10 ** p.12			
3	Teeter-totter... (Fulcrum)	3-11 thru 3-18	** p.97 ** p.98			
4	Cut-away engine (available at Museum of Science)	1-6 1-7 1-8	** p.81	6		6
5	Demonstration cut-away instruments	1-21;26 1-22;27 1-23	** p.84 ** pp.87-96			3
6	Wind tunnel airflow-smoke demonstration	1-4 1-5	** pp.6;8 pp.13,99, pp.13;101	3, 5		
7	(Tie in with 6 above-reference to aviation technical manual in library for suitable project design)			3, 4		
8	Construct on paper-diagram board	6-23 6-31	** p.72 p.73 p.74			
9	Role-play "violations" (of FAR's)	9-9 thru 3-6	Parts 61 and 91 of FAR's available in pamphlets		Sander-sons A-V F.A.R.'s (available on loan-American Aviation)	
10	Reference to Item #3 above-"CG"	3-1 thru 3-36	See especially: Comp: 3-15 Graph: 3-20 and Table: 3:26			
11	Visit flight simulator-National or Eastern			Contact: National Airlines, Mr. Ralph Heller--simulator Eastern Airlines, Mr. Joe Miller		
12	Use tape recorder; role-play	7-4 7-5 7-17 7-28	** p.146 p.147	4		
13	At airport (local fixed-bases operator)	1-32			4	
14	(Should be accomplished under Objective #13 above)					
15	Option: in classroom or in flight - teachers discretion					
16	Performance evaluation in gym.		(According to teacher standards of: duration; distance; weight and balance)			